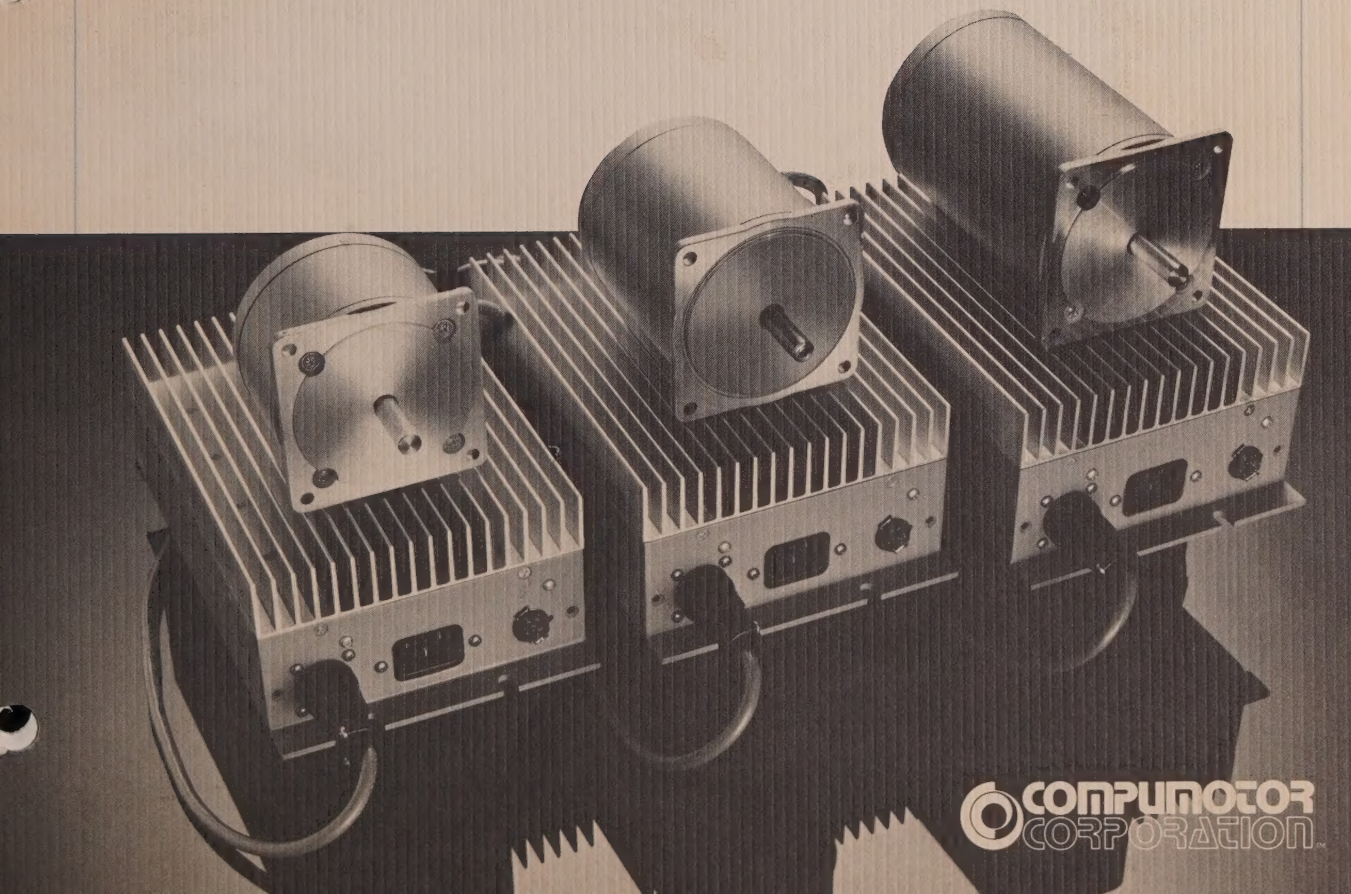
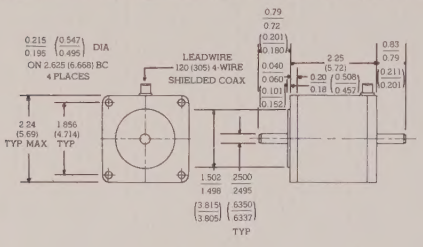
OPERATORS MANUAL

MOTORS AND DRIVERS

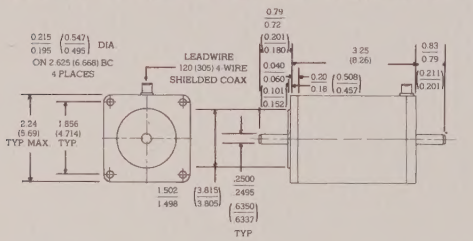


COMPUMOTOR CORPORATION

M57-51 40 OZ-IN (2.88 KG-CM) STATIC TORQUE



M57-83 80 OZ-IN (5.76 KG-CM) STATIC TORQUE



M57-102 120 OZ-IN (8.64 KG-CM) STATIC TORQUE

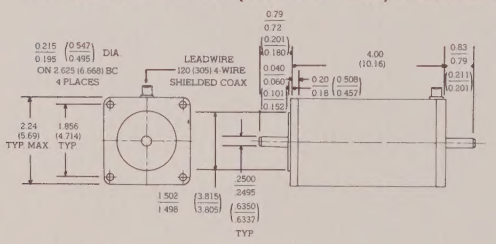
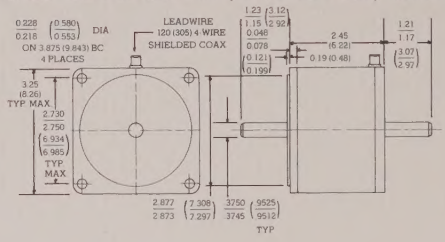
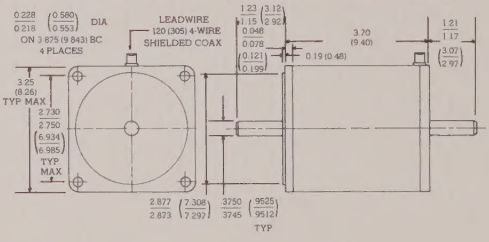


Fig. 1—M57 Series Motor Dimensions

M83-62 140 OZ-IN (10.1 KG-CM) STATIC TORQUE



M83-93 260 OZ-IN (18.7 KG-CM) STATIC TORQUE



M83-135 400 OZ-IN (28.8 KG-CM) STATIC TORQUE

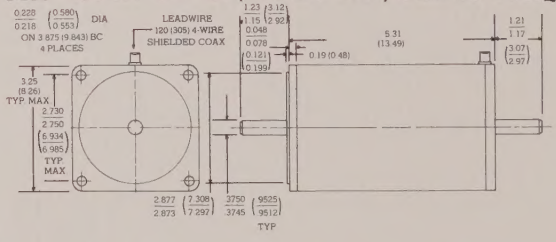


Fig. 2—M83 Series Motor Dimensions

M106-178 525 OZ-IN (37.8 KG-CM) STATIC TORQUE

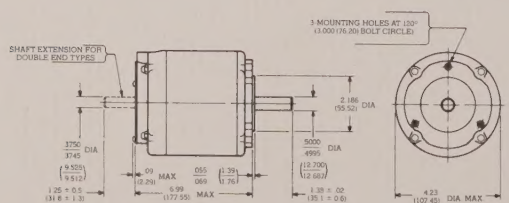


Fig. 3—M106 Series Face Mount

M106-120 800 OZ-IN (57.6 KG-CM) STATIC TORQUE

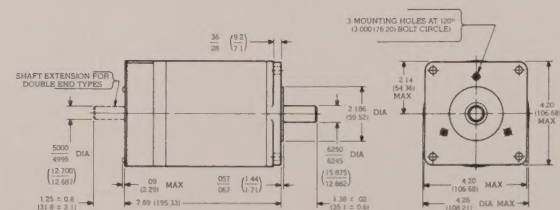


Fig. 4—M106 Series Flange Mount

COMPUMOTOR™ MOTOR/DRIVER SYSTEMS

INSTALLATION AND OPERATION MANUAL

DANGER!

Compumotor Corporation has made a special effort in the design and construction of its products to make them both versatile and easy to use. Our success must not cause the user to forget that the electrical and mechanical output of these products can be injurious or life threatening. They can also be capable of damaging or destroying the equipment to which they are connected if improperly installed, operated or serviced. Only persons qualified in servicing and installing hazardous voltage electrical and limited-travel mechanical systems should attempt this procedure.

This Manual has been designed to provide an introduction for the user with typical applications. Additional information is referenced for more complex needs. If this Manual fails to answer your questions, please call us Toll Free at (800) 358-9068 before proceeding (in California dial (707) 788-1244 Collect).

Inspection

Carefully inspect the shipping carton(s) for any evidence of physical abuse or damage and note any findings on the Waybill at the time of receipt. In cases of severe damage, it is recommended that the shipment be rejected entirely. Compumotor Corporation cannot be responsible for in-transit damage.

Unpacking

Use care in opening the shipping carton(s) so that the cables supplied are not cut or damaged. Verify the receipt of the following items:

Qty	Description
1	Compumotor with 10 foot (3M) Cord
1	Motor Driver (Power Amplifier) Module
1	3-Wire AC Line Cord (6 foot (2M) with Ground Pin)
1	Pulse Source Cable Kit
1	Option Check List
1	Application Note #1
1	Application Note #2
1	Application Note #3

Report any shortages and/or questions regarding ordered and supplied options directly to Compumotor Corporation.

Mounting the Motor and Driver

The three Series of Compumotors conform to NEMA Standard frame sizes as follows. Outline drawings of the flange mounts for the motors appear as Figures 1 through 4.

Compumotor Series	NEMA Standard Frame Size	Bolt Size	Bolt Grade SAE
M57	23	#8-32	3
M83	34	#10-32	3
M106	42	#10-32	3

The Compumotor should be mounted rigidly with the proper size and grade of hardware at all four corners. A dummy load of the approximate inertia listed in Appendix A should be mounted securely to the motor shaft for testing. Only collet-style mounting clamps are recommended for security and for concentricity between the load and the motor shaft. Compumotor Corporation will supply a simple dummy load for the M57 and M83 Series motors upon request. The appropriate part numbers are P/N 53-000536 for the M57 Series and P/N 53-000537 for the M83 Series.

The Motor Driver may be mounted some distance from the motor if the wire lengths and minimum wire sizes listed in Appendix B are observed. The location must be totally free from all liquids and protected from conductive chips and dust. The standard Compumotor is not suitable for explosive atmospheres, vacuum beyond 10^{-2} torr, or life-support equipment.

Mount the Motor Driver with the heatsink fins running vertically for best convection cooling (Figure 5). A minimum of 3 inches (7.62 cm) of clearance must surround the Motor Driver on the heatsink top and four sides. Ambient conditions for the Motor Driver are 32 to 122°F (0 to 50°) and 10 to 90% humidity (non-condensing).

Route the Motor Cable carefully so that movements of the motor and any attached mechanism(s) will not cause interference. Coil any excess cable at the Motor Driver and secure it with a cable tie. This cable carries high voltage (150 VDC) and all wire runs must conform to all applicable local electrical codes and OSHA requirements. Check that the model number of the Compumotor and the Power Amplifier have the same type number (i.e. M83-93). Rotate the Motor Cable Connector until it slips into the mating connector on the Motor Driver. Turn the Locking Collar clockwise until it is tight.

Electrical Connections*

Select a source of 117VAC power which is free from line drop outs and transient voltage spikes. The maximum current draw of the various Motor/Driver Systems is listed in Appendix B. Standard practices of sizing wire for these loads must be observed to minimize the voltage drop at the Motor Driver. Appendix C lists isolation transformers for 117VAC and step-down transformers for use with 230 VAC single phase power.

Prior to energizing the Motor Driver, manually turn the Compumotor shaft by grasping the outer radius of the dummy load. One should feel the magnetic detents characteristic of this type of AC synchronous motor employing permanent magnets.

Release the motor shaft and connect the AC power.

It is not unusual for there to be a snap or pop caused by the in-rush energy charging the Motor Driver power supply. Check that the rated holding torque is present at the Compumotor shaft. This may be done empirically by feel as the magnetic detent torque will have increased by at least one order of magnitude. A standard torque wrench may be used in place of the dummy load if a quick, quantifiable result is desired. Should the torque under power be low or nonexistent, proceed to Service Checkout.

> Do not connect or disconnect the Compumotor connector while the Motor Driver is energized because an arc could result in the connector. To do so voids the Warranty. Multiple motors may be connected, one at a time, to the same driver by use of the Remote Power Shutdown and external switches. Consult the Factory.

Pulse Source Connection

Compumotor Corporation's Application Notes 1 and 2 describe the theory of operation and practical circuitry for driving the Compumotor. Prepare the Pulse Source Cable Kit according to the following procedure:

Signal	Wire Color Code	Connector Pin Number	
Direction Input (+)	Green	A	20 ma
Direction Return (-)	White	E	
Step Input (+)	Red	B	20 ma
Step Return (-)	Black	D	
Remote Shutdown (+)	Blue	C	20 ma
Shutdown Return (-)	Brown	F	
Chassis Ground	Shield (Drain)		Not Connected at Driver End

Check the cable for continuity and possible shorts prior to use. Use a dummy load of 180 ohms to ensure that a minimum of 20ma is available to drive each of the opto-isolator inputs (HP #HCPL 2530).

*Caution: Hazardous voltages inside. Refer installation and servicing to qualified personnel only.

Set the pulse rate of your chosen pulse source to zero. Connect the Pulse Source Cable to the Motor Driver. Make sure that the Remote Power Shut-down Option (if installed) is in the Run Mode (Logical "0" on Pin C).

Compumotors are designed to be accelerated and decelerated. Circuitry to achieve controlled changes in velocity are shown in Application Note #2. Compumotor Corporation provides an extensive line of preset indexers for creating the necessary velocity profiles and controlling total distance moved.

Gradually increase the pulse rate until the dummy load begins to noticeably rotate. Decrease again to zero and change the logic state of the Direction Input. Increase the pulse rate and observe the change in direction of the Compumotor shaft. Return the pulse rate to zero. Simple frequency counters are helpful at this stage to observe velocity changes.

If using one of Compumotor Corporation's Preset Indexers, perform the above test by doing the following:

151 Controller or 1200 Series Controller

1. Set the Mode Switch to "Preset" (151 Controller) or "Single" (1200 Series Controller).
2. Dial in "10" rev/sec^2 on the Acceleration thumbwheels.
3. Dial in "10.00" rev/sec (151 Controller) or "10.000" rev/sec (1200 Series Controller) on the Velocity thumbwheels.
4. Dial in "+20.000" revolutions on the Position thumbwheels.
5. Depress "Start".

If using the 1200 Series Controller with RS-232C Computer Interface do the following:

1. Type "MN A10 V10 D20 G (Carriage Return)"

All of the above will accelerate the motor at the rate of 10 rev/sec^2 until a velocity of 10 rev/sec is reached (5 complete revolutions or 1 second). After completing a total of 15 revolutions, the motor will begin to decelerate at the rate of 10 rev/sec^2 to a stop. When stopped, it will have completed exactly 20 revolutions in three seconds.

Limited-Travel Mechanisms

Before connecting the actual load to the shaft of the Compumotor, all limited-travel mechanisms must be protected by the use of electrical limit switches. If one of the Compumotor Preset Indexers is used, follow the instructions included with those units. In other cases, a limit switch must signal the need for a controlled deceleration at the maximum rate possible. This rate must be consistent with load inertia and maximum load of the motor.

Note that since the required limits are not the "End-of-Travel" type, they must be tripped far enough before the mechanical stop to allow the load to be safely decelerated. This distance may be computed using the Braking Curves of the appropriate Motor Specification Sheet and the formulas given in Application Note #3. It also may be determined empirically by initiation the deceleration cycle in the middle of travel and measuring the distance required to stop.

NOTE!

Interrupting Motor Pulses with Limit Switches Leaves Only Load Friction and Minimal Motor Detent Torque to Decelerate the Load Out of Synchronization. It is Not Recommended.

Dynamic Characteristics of the Compumotor

A Compumotor is a special case of an AC synchronous induction motor driven by a 20 KHz, bi-polar, chopper power amplifier. Its complex wave-shaping circuitry allows significant compensation for many of the mechanical and electrical imbalances inherent in all motor designs. The computer-controlled proportioning of current simultaneously between multiple windings gives high torque at low speed without the jarring accelerations of traditional stepper motors.

The precision of our drive proportioning techniques yields exceptional repeatability while maintaining the open-loop accuracy and ease of use characteristic of stepper motors. The Compumotor also shares the dynamic response curve of the stepper motor and its stall characteristics. That is, full torque under acceleration is developed at a lag angle of approximately 1.8^{o}. Loading which causes a larger lag angle will result in the motor losing position.

In cases of severe overloading, the rotor will lose synchronism with the rotating magnetic vector of the stator and the rotor will stop. The Compumotor has been designed to allow a continuous stall condition under overload without damage to the Compumotor or the driver. If the motor is stalled, however, the rotating magnetic vector must be stopped and the cause of the overload condition remedied before the Compumotor may be restarted and run successfully.

The dynamic error under acceleration will be recovered when a constant velocity is reached, or when the Compumotor is stopped. How much error is returned depends heavily on load friction and stick-slip characteristics of the load. The degree of recovery would therefore, have to be determined empirically. If using Compumotors or stepper motors in multi-axis systems, the error under load (if excessive) could be compensated for in the master control system. Decelerating produces a similar error condition as the motor leads the load.

Maintenance

Periodically check the Compumotor mounting bolts and shaft couplings. The Class I ball bearings used in the Compumotor are permanently lubricated and require no maintenance. There are no serviceable items in the Compumotor or maintenance items such as brushes.

The strain relief and cable should be inspected occasionally at the Compumotor for signs of wearing or excessive force being applied to the cable. Tighten both cable connectors at the Driver. Check that the Driver heatsink is free of dust and dirt and has a free flow of air over its entire surface.

Service

If problems develop in the operation of the Compumotor, refer to the following list of symptoms and causes to identify or localize the problem:

1. Motor Fails to turn
   (a) No AC power.
   (b) Bad connections or bad cables.
   (c) No Step signal coming to Driver - check that a pulse train meeting all requirements for voltage, current and pulse width is available (3.5 to 6V @ 20 ma minimum, 500 nsec pulse width min).
   (d) Load is jammed - remove AC power from the Driver and verify that the load can be turned manually.
   (e) Tripped or faulty limit switches - make sure that control signals are not being inhibited by limit inputs to a preset indexer or supervisory logic.
   (f) Driver output is being turned off by Remote Power Shut-down Option - Pin C of the input cable to the Driver should not be high relative to Pin F.
   (g) Blown Driver AC line fuse - disconnect AC power from the Driver and dismount it from the surface to which it is attached. Remove the four Phillips-head screws which retain the sheet metal cover on the long sides of the Driver. Remove the four screws on the short edges of the end plates. Slip off the cover and inspect the fuse. If the fuse is blown, check continuity of the output transistor junctions. If one or more of these transistors is shorted, return the unit for repair. If the continuity checks are satisfactory, replace the fuse with the value shown in Appendix B <u>only</u> (Substituting a larger value voids the Warranty). Reassemble the driver. reconnect the Compumotor and the AC power and test. If the fuse blows again, servicing and repair is indicated.

Notice: Probing of the Driver with AC Power Applied Must Be Done Only By Qualified Electronics Service Personnel Using an Isolation Transformer on the AC Input to the Driver.

2. Motor Stops During Acceleration

   This condition indicates an overload condition caused by excessive torque requirements and/or too steep an acceleration ramp. Refer to Compumotor Applications Note #3 for calculations of torque. A larger motor and/or lower accelerations may be indicated.

3. Motor Fails to Run Above 20 rps (1200 rps)

   This may be a torque problem but, more likely, it has to do with load/Compumotor interactions which can stimulate parametric oscillations and stall the Compumotor. The addition of friction, system dampening or mechanical redesign to minimize mechanical resonances may be required singly or in combination.

4. Motor is Jerky, Noisy or Weak

   Check that there are no mechanical problems at the load causing highly variable loading conditions at the Compumotor shaft. Disconnect the Compumotor from the load and run it with a dummy load connected. If the problem persists, service repair is indicated.

Factory Service

To return the Compumotor for repair or to order replacement parts, obtain the model and serial numbers of the Motor and Driver. Call the Compumotor Service Department for return authorization. In California call collect: (707) 778-1244, otherwise call toll free: (800) 358-9068. Return the Compumotor and Driver, freight prepaid, to:

Compumotor Corporation
1310 Ross Street
Petaluma, CA. 94952

Attn: Service Department

DUMMY LOAD PARAMETERS

Motor	Inertias		Dummy Load Dimensions For An Aluminum Disc	
	Rotor ($oz\text{-}in^2$)	Dummy Load Approx. ($oz\text{-}in^2$)	Diameter (in)	Thickness (in)
M57-51	0.48	2	4.00	0.063
M57-83	1.28	5	4.75	0.063
M57-102	1.75	7	4.50	0.125
M83-62	3.50	10	4.80	0.125
M83-93	6.70	15	5.30	0.125
M83-135	10.24	25	6.00	0.125
M106-120	21.50	50	7.20	0.125
M106-178	44.00	100	8.50	0.125

Note: These dummy load inertias are arbitrary and do not represent the minimum or the maximum inertias that can be applied to the motor.

APPENDIX A

MINIMUM RECOMMENDED WIRE SIZE (AWG)

Motor Series	Maximum Current per Phase (A)	Less Than 100 ft (30.5M)	100-200 ft. (30.5-71M)
M57	1	22	20
M83	2	20	18
M106	3	18	16

1. Cable runs of over 200 ft. (71M) are not recommended.

2. Voltage drop per motor phase = (cable $\frac{\text{length (A)}}{100}$ x 2) x R

where R = wire resistance in ohms per 100 ft.

Wire Size (AWG)	R (ohms/100 ft.)
16	.4
18	.64
20	1.0
22	1.6

APPENDIX B

COMPUMOTOR ACCESSORIES

Motor Series	Flexible Coupling P/N	Inertial Damper P/N*	Transformer P/N 117/VAC Isolation	Transformer P/N 230/VAC Step-Down	Rating (VA)
M57	73-000758-01	58-000697	47-000651	47-000654	85
M83	73-000758-11	58-000698	47-000652	47-000655	250
M106		58-000699	47-000653	47-000656	500

*Double shafted motors only

APPENDIX C

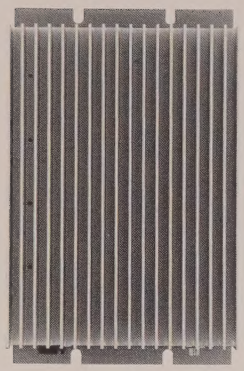
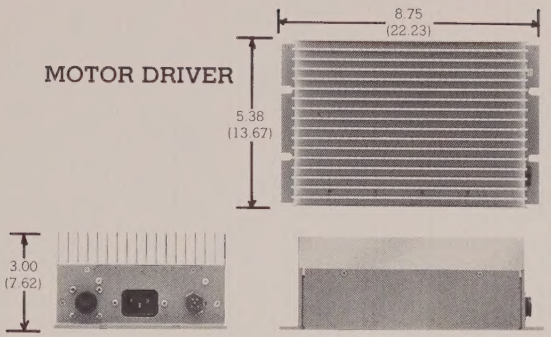


Fig. 5—Driver with Heatsink Mounted Vertically



Heatsink Fin Area is 350 in² (2258cm²)

Fig. 6—Driver Dimensions

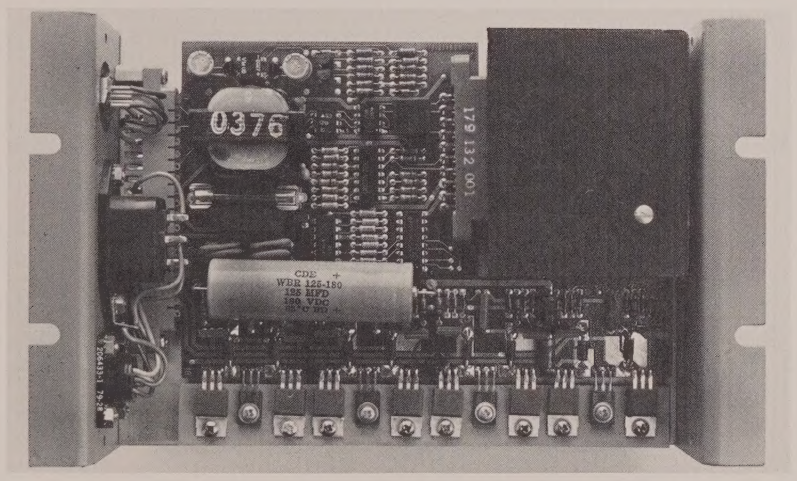


Fig. 7—200 Watt Driver

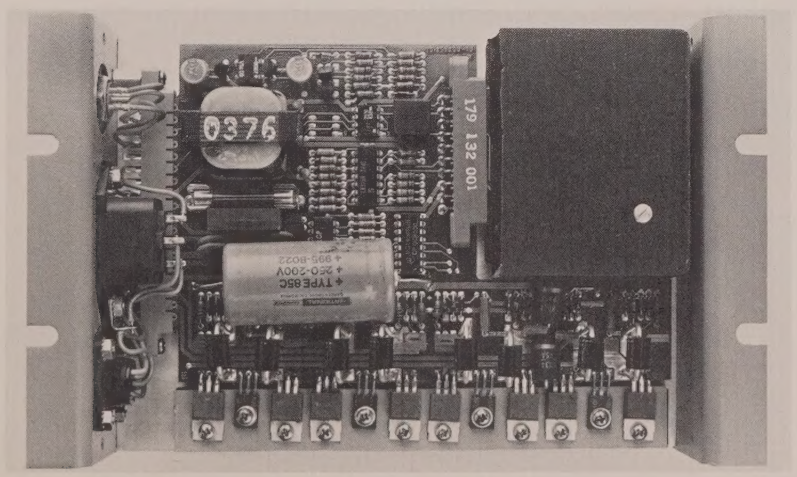


Fig. 8—600 Watt Driver

LIMITED WARRANTY.

Seller warrants that the products sold will be free from defects in material and workmanship and perform to Seller's applicable published specifications for a period of 1 year from date of shipment. The liability of Seller hereunder shall be limited to replacing or repairing, at its option, any defective units which are returned F.O.B. Seller's plant, Petaluma, California. In no case are products to be returned without first obtaining permission and a customer return order number from Seller. In no event shall Seller be liable for any consequential or incidental damages.

Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation are not covered by warranty. Seller shall make the final determination as to the existence and cause of any alleged defect. No liability is assumed for expendable items such as lamps and fuses. No warranty is made with respect to custom equipment or products produced to Buyer's specifications except as specifically stated in writing by Seller in the contract for such custom equipment.

This warranty is the only warranty made by Seller with respect to the goods delivered hereunder, and may be modified or amended only by a written instrument signed by a duly authorized officer of Seller and accepted by Buyer.

Except as hereinabove provided, SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

www.manualsplus.com

1019070

The Computer Movement that started a Revolution

COMPUMOTOR CORPORATION™
1310 Ross Street, Petaluma, CA. 94952 (707) 778-1244